

J. Cushman

CUSHMAN LABORATORY
FOR
FORAMINIFERAL RESEARCH

MEMORIAL VOLUME

SHARON, MASSACHUSETTS, U. S. A.

APRIL, 1950

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Joseph Augustine Cushman was born January 31, 1881, at Bridgewater, Massachusetts, the son of Darius and Jane Frances (Fuller) (Pratt) Cushman. His family, on both his mother's and his father's side, was of English origin and his ancestry was traceable to ten of the Pilgrims who came to New England in the *Mayflower*. He was a late child of this union which for both his parents was a second marriage. His father had a store facing the green where he sold and repaired shoes in Bridgewater, a college town. The town itself was founded very early in American history, having been one of the first to be settled by the Pilgrims as they moved inland from Plymouth.

Besides his parents, his immediate family consisted of a much-older half-brother (son of Darius) who soon left the family home, an elder brother who died when Joseph was 3, and his grandfather, Thomas Cushman, with whom the family lived from 1883 to 1889. Before her marriage to Darius, his mother had lost her daughter and her husband. Of this, Dr. Cushman learned quite by accident after his mother's death, such is the ability of New England women to close the door firmly on the past.

Neither his father nor his mother were well physically, and his father was lame and walked with increasing difficulty. In spite of this, however, he loved the out-of-doors and sometimes took Joseph into the nearby woods and fields to sit watching and listening to the birds and the myriads of other creatures that reveal themselves to interested eyes and listening ears. Joseph's love of nature and keen powers of observation, learned in his boyhood, persisted to the end of his life.

From his many and often recounted recollections of him, Joseph thought a great deal of his grandfather Thomas Cushman, with whom the family lived until Joseph was 8. Thomas Cushman had been a schoolteacher for some 34 years and a representative of the Town of Bridgewater in the State Legislature. Dr. Cushman treasured a bit of philosophy in his grandfather's handwriting written on his 90th birthday:

The best preparation for all the uncertainties of futurity consists in a well ordered mind, a good conscience, and a cheerful submission to the will of Heaven.

The six years spent on his grandfather's farm, alongside a river, not far from the center of Bridgewater, seemed in retrospect very happy ones.

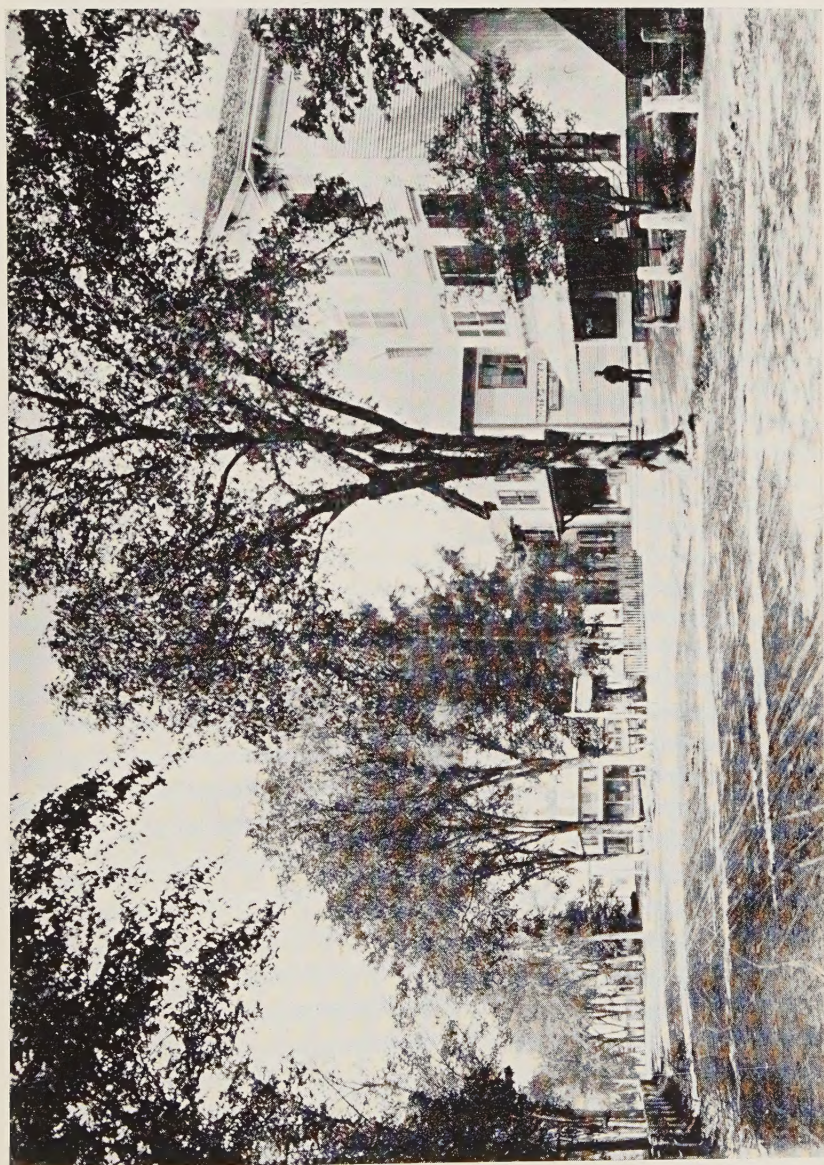
Joseph's early schooling was in the town where he was born, starting public school in 1885 at the age of 4½. He entered Bridgewater High School at 12 and graduated at 16 in 1897. His plans were for a medical education, with the intention of becoming a surgeon, but the death of his father just after his graduation from High School, made it imperative for him to abandon these plans. Then followed years in which Joseph and his mother were in rather difficult financial circumstances, necessitating him to help in the family support by a variety of before- and after-school jobs, and his mother took Normal School students to board.

Although under age, he was allowed to enter Bridgewater Normal School, provided a four-year course were taken. During these years his interest in science as a profession was aroused and his first leanings were toward botany. His first geology course was from Professor Charles P. Sinnott. At Normal School he was active in athletics and became captain of the School baseball team in his senior year. Skating, also, was a favorite sport. He was a charter member and first president of Kappa Delta Phi, professional educational fraternity which was first organized at Bridgewater Normal School in 1900.

Full as his days must have been, they were not too full to allow occasional rowboat explorations on Carver's Pond at the edge of Bridgewater, where, in his budding enthusiasm for all branches of natural science, he went to study and collect almost all manner of things. The desmids collected there formed the subject of one of his earliest publications.¹ Carver's Pond was in a way symbolic of the beginning of his career and seemed to hold a special charm for him throughout his life. He often drove by it in later years, seeing a part of it in the distance, and at one time spoke of renting a boat and going out on it once more; but then he said, "No, it wouldn't be the same now. I'll remember it as it used to be."

Upon his graduation from Bridgewater Normal School in 1901 he obtained a scholarship to Harvard University and in the fall of 1901 he entered the Lawrence Scientific School with junior standing. His intention was to specialize in cryptogamic botany but a course in paleontology under Dr. Robert Tracy Jackson interested him to the extent of his changing his major to that field. At Harvard he continued to supplement his funds by waiting on table and by tutoring, and it was a matter of pride to him that he had been able to work his way through college. He had always been an excellent student and graduated *magna cum laude* with the Harvard Class of 1903.

¹ List of desmids found in Carver's Pond, Bridgewater, Massachusetts. *Rhodora*, vol. 5, No. 51, March 1903, pp. 79-81.



Central Square, Bridgewater, Massachusetts, in the late 1800's. The Cushman home and store, facing the green, is at the right of the center, the house bearing the sign Boots and Shoes.

After his graduation from Harvard, he obtained a position with the Boston Society of Natural History as Curator, but continued part time studies at Harvard toward his doctor's degree which he received in 1909, 6 years later.

During his senior year he had been assistant to Dr. Jackson and there quickly sprang up between them a strong affection which lasted undiminished to the ends of their lives. A letter written to Dr. Cushman's first wife on the occasion of his passing the doctor's examinations reveals the high esteem the teacher had for his pupil:

9 Fayweather St.
Cambridge -
10 June 1909

Dear Mrs. Cushman -

I want to tell you how glad I am that Mr. Cushman has passed his examinations all right for the degree of Doctor of Philosophy. His thesis is also most satisfactory to me, a contribution to science of high value in its originality of treatment and in a group of animals in which such work has never been tried so that it has the added value of path making work.

In addition to the scientific work he has accomplished you have every reason to be proud of him for the strong character he has shown in sticking to his work under great difficulties.

You have my hearty congratulations which please extend to his mother too in that he has shown the stuff that real men are made of and keen scientific abilities as well.

I feel grateful as a teacher that he felt he could get from me what he wanted and that it has had a so successful outcome.

With best wishes for you all -

Yours very sincerely -

Robert T. Jackson

Several summers during the period of his association with the Boston Society of Natural History were spent on botanical collecting trips for the Museum. His collections were some of the first from northern New England: Moosehead Lake, Spencer Mountains, Mt. Katahdin, and down the Allagash in Maine; the Belknap Mountains in New Hampshire; and Lake Champlain in Vermont. His knowledge of botany thus gained was quite remarkable in a field not his own, and his acquaintance with birds and bird songs was also outstanding.

On October 7, 1903, he married his sweetheart of Normal School days, Alice Edna Wilson of Fall River, Mass. Three children were born to them: Robert Wilson, Alice Eleanor, and Ruth Allerton (Mrs. H. Eric Hill). His grandchildren are Robert Lincoln Cushman, David William Hill, Kenneth Cushman Hill, Norman Eric Hill, and Alice Edith Hill. When, in 1909, it was discovered that his wife had contracted tubercu-

losis, he brought his family including his mother out from Cambridge to Sharon, a small town south of Boston. His mother died in 1910 and his wife January 25, 1912. Leaving his three young children in the care of one of his nieces and a nurse and a maid, he went that spring with Dr. Jackson on the Carnegie Institution Expedition to Jamaica.²

Shortly after the death of his wife, Miss Susan Rich Trueworthy of Rockland, Maine, was engaged to care for his three children. She had previously been a kindergarten teacher in the Cushman School of Brookline, a private day-school founded by one of Dr. Cushman's cousins. For twenty-six years, until her death in 1938, she remained as a beloved member of the Cushman family.

On September 3, 1913, Dr. Cushman married Frieda Gerlach Billings of Sharon and moved with his family into a newly built home at the edge of woods in Sharon a short distance away from his former home. Mrs. Frieda Billings Cushman has devoted her life to the maintaining of a beautiful and gracious home where hundreds of students, together with their families, have been made welcome guests for longer or shorter periods as they came to call upon or study with Dr. Cushman. It is quite impossible to conceive of the Laboratory without the Cushman home; the two complemented each other in so many ways. The contribution of Mrs. Cushman to the many successful years of the Laboratory's existence, and to the work Dr. Cushman was able to do in it, are impossible to estimate.

Dr. Cushman continued his work at the Boston Society of Natural History, having become Museum Director in charge of Exhibition Collections in 1920. During two earlier summers (1904 and 1905) spent at the U. S. Fish Commission at Woods Hole, he had met Miss Mary J. Rathbun who had urged him to undertake the much-neglected study of Foraminifera. She arranged through her brother, Dr. Richard Rathbun, then head of the U. S. National Museum to have sent up for study the collections of Recent Foraminifera taken by the U. S. Fish Commission Steamer *Albatross* in her several world-wide expeditions between 1883 and the first decade of the 1900's. Examination and classification of this rich and excellently-preserved material enabled Dr. Cushman to understand more clearly the significance of various features of the tests and to see new family relationships. Publishing in several series, mainly U. S. National Museum Bulletins (Nos. 71, 100, 104, and 161*) and Proceedings, he began the systematic identification and description of the Recent

² Foraminifera from the north coast of Jamaica. Proc. U. S. Nat. Mus., vol. 59, June 10, 1921, pp. 47-82, pls. 11-19, text figs. 1-16.

* The fourth and final part of Bulletin 161 is still to be completed.

Albatross material. In the earlier of these papers he followed the Bradyian classification in general use at that time, but he soon came to the inescapable conclusion that in his new understanding of the group a new classification was taking form, although it was some years before it became concrete enough to be presented. Following Haeckel's principle of recapitulation as applied to the study of echini by his teacher, Dr. Jackson, and previously by Dr. Alpheus Hyatt to the study of nautiloids, Dr. Cushman³ began to study the Order *Foraminifera* as a whole; to recognize the many cases of parallelism and to realize that the structure of the test and the material of which it is made are of greater significance in classification than merely external shape of the test. Two publications, separated by less than two years, represent the old⁴ and the new⁵ classifications, and it is of interest to note that in the former (p. 14) there are strong hints of the latter soon to come. It is characteristic of Dr. Cushman that in the presentation of almost any view he added such phrases as "the classification is not in any sense a final one," "as more is learned," "more and better specimens are needed to determine," and "the genus or species should be searched for in rocks," all expressions of his attitude toward his science, his realization that virtually nothing was certain and unchangeable.

In the original presentation⁵ of Dr. Cushman's classification in 1927, he expanded the ten-family classification he had been using to 45 families. This 1927 version became widely accepted and was continued with only minor changes through four subsequent editions (1928, 1933, 1940, and 1948). The latest edition includes 50 families, two of which, *Pegidiidae* and *Victoriellidae*, were added at the time of the 1933 edition and three of which resulted from the separation of the *Fusulinidae* and *Orbitoididae*.

In 1912 Dr. Cushman became associated with the United States Geological Survey, and during a part of the war years, he did some general field mapping (not related to *Foraminifera*) in the coastal areas of the Carolinas. After some months in the field he became ill and returned to Sharon. He was a sergeant in the State Guard in the first war, and secretary of the local Public Safety Committee. In the second war he served as air-raid warden and plane-spotter.

Dr. Cushman's first published work bearing on the economic use of

3 Developmental stages in the *Lagenidae*. *American Naturalist*, vol. 39, No. 464, Aug. 1905, pp. 537-553, pl. 1, text figs. 1-25.

4 An introduction to the morphology and classification of the *Foraminifera*. *Smithsonian Misc. Coll.*, vol. 77, No. 4, July 21, 1925, pp. 1-77, pls. 1-16, text figs. 1-11.

5 An outline of a re-classification of the *Foraminifera*. *Contr. Cushman Lab. Foram. Res.*, vol. 3, pt. 1, Feb. 28, 1927, pp. 1-103, pls. 1-21.

Foraminifera appeared as a brief report included in U. S. Geol. Survey Prof. Paper 90-H (Dec. 31, 1914) by L. W. Stephenson on the deep water well at Charleston, South Carolina. It gave impetus to the detailed study of foraminiferal faunas in well sections in commercial work in the petroleum industry.

Dr. Cushman was a delegate to the First Pan-Pacific Science Congress in Hawaii in 1920, at which he presented a paper, *Status of the general knowledge of the Pacific Foraminifera*.⁶ A short time previously he had been offered the directorship of the Bishop Museum there. It was a hard decision he made in declining it and he said later that if he had seen Hawaii first his decision might have been different.

Dr. Cushman severed his connection with the U. S. Geol. Survey at the end of 1921. Late in 1922 he accepted a position as consultant geologist for the Marland Oil Company and left Boston January 5, 1923, for a few weeks' trip to Mexico on his new commission. The few weeks were extended into a few months and it was not until the end of March that he returned. Characteristically with his mind far ahead, plans had been made during his trip back, for the Laboratory to be built with part of the money received as his fee. Construction of the building was commenced the following Monday morning, April 2nd. The completed Laboratory was ready for occupancy the following August and he continued to carry on his consulting work for Marland with a small staff of laboratory assistants and a representative of the company, and subsequently another company, until the end of 1925. At that time he gave up his connections with consulting work and returned to the U. S. Geological Survey on a part time basis and at a token salary compared to his income of the previous three years, in order to be free to devote his time and energy to pure research. He had resigned from the Boston Society of Natural History in May 1923, shortly after his return from Mexico.

From the beginning of work in the Laboratory until the present, Dr. Cushman's elder daughter, Alice, has been his secretary, performing much invaluable yeoman service over the twenty-six years since the founding of the Laboratory. Her carefulness and devotion have been a large factor contributing to Dr. Cushman's freedom and time for research.

In the fall of 1926, two students, James A. Waters and Reginald W. Harris, who were then registered at Harvard, made private arrangements to study at the Laboratory. This led to Dr. Cushman's offer in 1926 to accept graduate students from Harvard, Radcliffe and M. I. T., and accordingly, he was appointed Lecturer and the course became an of-

⁶ Special Publ. Bernice P. Bishop Mus. No. 7, 1921, pp. 284-289.



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1. Joseph A. Cushman at about 7 years old.
2. Joseph A. Cushman at graduation from High School in 1897.
3. Joseph A. Cushman at work in the Laboratory in the late 1920's.
4. Joseph A. Cushman near the Laboratory August 1934.
- 5, 7. Dr. Joseph A. Cushman in academic costume on the occasion of the presentation of the Honorary Doctor of Science degree from Harvard University June 1937.
6. Dr. Joseph A. Cushman in the Laboratory February 1946.

ficially credited one. For twenty-three years he gave his services without stipend to Harvard and during that time had many students, not a few of whom subsequently entered the field of micropaleontology. His classes were very informal and the students all came out to the laboratory at Sharon. In addition to students from the colleges, he also accepted various others on a private basis and many came, both from the United States and abroad. His students were a never-failing source of pleasure and inspiration to him.

Two trips to Europe were made to study type collections and to collect from the classic type localities. In 1927 he and Mrs. Cushman were accompanied by their younger daughter, Ruth, and on their second trip in 1932 they took with them two of the Laboratory staff: Miss Frances L. Parker and Miss Margaret S. Moore. On both trips much was accomplished which enabled Dr. Cushman to improve and set on a firmer basis his own work. True to his systematic habits, he planned in detail his itinerary so as to include the Museums, Institutions, and collecting localities he particularly wished to visit, making advance arrangements as an official representative of the Smithsonian Institution, sending advance requests to examine the specific collections in the various repositories. He took with him four loose-leaf notebooks in which he had the original description of each species he hoped to see, typed at the top of the page and a photographic copy of the type figure pasted onto the page, with the rest of the page left blank for notes to be made while examining the actual specimen. He also carried with him numerous slides of specimens which he had tentatively identified previous to going, and while there he either confirmed the identifications or made notes as to how the American specimens differed from the European ones. His artist, Miss Moore, made many re-drawings of specimens which had been very conventionalized in the original illustration. Preparatory work of blacking around outlines was done in Sharon before leaving so that a maximum of work could be accomplished in Europe. Miss Parker did considerable mounting of specimens where duplicates were available for exchange. The contacts made with European micropaleontologists and the exchanges initiated during these trips were of great value to his work. The 1927 trip was chiefly in France, Italy, and England, and the 1932 trip particularly in Germany and Austria.

In April 1925 the first number of a quarterly publication, called *Contributions from the Cushman Laboratory for Foraminiferal Research* appeared. Inside the front cover Dr. Cushman wrote:

It is proposed to issue these contributions quarterly. They will contain short papers with plates, describing new forms and other interesting notes on the general research work on the foraminifera being done on the group by the workers in this laboratory. New literature as it comes to hand will be briefly reviewed.

Seven *Contributions*, all brief articles, varying in age of sediments dealt with (Cretaceous to Later Tertiary), geographic regions (North America and Europe), and subject matter (formal description, and discussion of the nature of a cristellarian aperture, plus review of eleven foraminiferal papers), comprised the first issue of 21 pages of text and 3 plates of figures.⁷ This set the pattern for twenty-five volumes, one hundred issues, extending over the following twenty-five years, consisting of about 2700 pages and 418 plates, a journal which became, after a few years, financially self-maintaining. The *Contributions* in these twenty-five volumes number 332, the great majority by Dr. Cushman alone or with his many co-authors, and represent a considerable monument to his prodigious working capacity.

In 1928 Dr. Cushman published, in textbook form, his classification expanded from the original presentation of it in early 1927. This text book, *Foraminifera, their classification and economic use*, he called Special Publication No. 1 and it formed the starting point for a second series, the *Special Publications of the Cushman Laboratory for Foraminiferal Research*. These larger papers were made possible initially by gifts of money received from his wife, his daughter Alice, and Miss Susan Minns, a cousin of Mrs. Cushman who had been educated in botany at M.I.T. in the days when parental disapproval of a scientific career for a woman made it impossible for her to participate actively in scientific work. Various other smaller sums were received from a number of other individuals, and in the later years the Special Publications also became a self-supporting series.

Dr. Cushman's distinguished contributions to science were recognized by his university in 1937 in the conferring of the honorary degree of Doctor of Science upon him, in these words:

A pioneer biologist whose microscope explores the geologic ages,
a guide to men who pierce the earth in search of liquid treasure.

Thus, on this occasion, he achieved the unusual distinction of having received his three degrees from three successive Harvard presidents: Charles W. Eliot, A. Lawrence Lowell, and James Bryant Conant.

In 1938 he was elected Honorary Fellow of the Royal Microscopical Society of London. The Hayden Memorial Geological Award and Gold

⁷ It is of interest that of the 29 forms included in this first issue, one genus, twenty-five species, and one variety were described as new.

Medal for 1944 was given him in December 1945 by the Academy of Natural Sciences of Philadelphia. He was affiliated with numerous scientific organizations, serving several in various capacities: Society of Economic Paleontologists and Mineralogists, president, 1930-31; Paleontological Society, president, 1937; Geological Society of America, vice president, 1938; National Research Council, Chairman of Committee on Micropaleontology, 1930-1946. He was Editor of the Journal of Paleontology for the three years from its beginning until March 1930. He was a member of the Harvard Chapter of Sigma Xi. He was a 32° Mason and a Knight Templar and a member of the Independent Order of Odd Fellows.

Dr. Cushman's physical strength and courage to keep going in spite of his increasing weakness and pain were exceptional. One of the last letters he wrote (February 14, 1949) ended with these words: "However forams are still interesting and we are going ahead." He continued to walk to the Laboratory every day to do at least some work until March 19th, just four weeks before his death on April 16th, 1949.

Dr. Cushman was a person of many interests and many talents. His independent nature and habit of making quick decisions tended to result in a household adapted to rapid adjustments. Life in the Cushman family was never dull or prosaic. His recreation he indulged in with as much zest and vigor as he did his work. Camping, fishing, mountain-climbing, travelling the back roads of his beloved New England, capturing the real feeling of the countryside with his paints or his color camera, were some of his favorite pastimes. That he loved New England, in spite of a sometimes austere outlook, there was never any doubt. A favorite quotation of his were these lines from Whittier's *Last Walk in Autumn*:

Then ask not why to these bleak hills
I cling, as clings the tufted moss,
To bear the winter's lingering chills,
The mocking spring's perpetual loss.
I dream of lands where summer smiles,
And soft winds blow from spicy isles,
But scarce would Ceylon's breath of flowers be sweet,
Could I not feel thy soil, New England, at my feet!

Whittier's *Snowbound*, also, was a favorite poem, and he knew many lines of it by heart. His interests varied from time to time from gardening (flowers, vegetables, and fruit trees) to poultry-raising. A beautiful collie, Bruce, was his much-loved companion for six years.

His collection of stamps grew to large proportions through his wide foreign correspondence. As another hobby, he worked out a rather com-

plete genealogical study of the first seven generations of Cushmans in New England, over a thousand descendents of Robert Cushman who came to Plymouth Colony in 1621. This work was done with his characteristic systematic method, complete with references to Vital Records and photographs of headstones. He enjoyed this as a search for the missing pieces of a jig-saw puzzle or the filling in of blank spaces in a crossword puzzle.

He was quick and skillful with several media of illustration: pen-and-ink, pencil, pastel, water color, and oil. Many of the drawings for his papers he did himself. At one time Mrs. Cushman made a remark to the effect that if she should collect anything, she would like to collect penguins, but she didn't think she would because they would be so much trouble to dust. Her hearers overlooked the second half of her remark and soon penguins, in all sizes and materials, began to appear. Over many years Dr. Cushman added to her collection penguins not requiring dusting: penguin pictures. In one series the penguins appear as historical characters and the pictures depict early American history. In another series the penguins appear as members of the Cushman household and the penguin pictures depict in caricature many episodes in Cushman family life.

Dr. Cushman was Unitarian in religion and keenly sensitive to the implications of religion in his own life. He had been brought up in the Swedenborgen Church in Bridgewater, of which his grandfather Thomas Cushman was a charter member. At Harvard, he listened with interest to many ministers as they spoke in the college chapel where they seemed to be free of the narrow denominationalism which bound them in their own churches. It was during his college years that he came to know the Unitarian Church as representing most closely his own attitudes and beliefs. He was a faithful and devoted member of the Unitarian Church in Sharon to the end of his life.

Personally, he was quiet and very unassuming, but yet friendly and most generous when once he recognized the spark of genuine interest in his students. His sense of humor was a delight to those who knew him.

He was ever humble in receiving the gratitude of his students and often replied to their thanks: "We can never repay what we have received, but can only pass it on to some one else."

I am indebted to many persons for information included above, most particularly to Mrs. Joseph A. Cushman, Miss Alice E. Cushman, and Mr. Robert W. Cushman.

RUTH TODD

HISTORY OF THE CUSHMAN LABORATORY

as recalled by Alice E. Cushman who has seen it from the beginning —

It was on Wednesday, March 28th, 1923, that Dr. and Mrs. Cushman returned to Sharon from Mexico. Plans had already been formulated and sketched on paper for a small laboratory to be built, in which to carry on the systematic examination of samples which were to be received from the Mexican field. Actual construction of the building was started the following Monday morning, April 2nd, and the work was completed in twenty weeks, so that the Director and small staff of assistants moved in and began their work on Monday, August 20th.

The Laboratory is a small one-story house consisting of four rooms and an entrance hall, an attic for storage and a basement with preparation and washing room, photographic room, dark-room, and furnace room. In two of the work rooms, built-in tables and drawers added to the convenience of the workers. Cases of specimens, book cases housing the library, and drawers containing the card catalog, occupied the other two rooms.

The Laboratory building is situated about 500 feet from the Cushman home at the edge of woods and on a slope overlooking a wooded valley through which a brook flows to the northward. Although the Laboratory is visible from the house, the path to it passes through a short stretch of woods which opens out in an orchard adjoining the Laboratory.

The original staff in that fall of 1923 consisted of Dr. Cushman, Director; Mr. Earl A. Trager, representative of the Marland Oil Company; Miss Alice E. Cushman, secretary; Miss Evelyn Seibert, secretary; and Miss Jennie Cushman, niece of Dr. Cushman, who picked and mounted specimens.

For the first two years of its existence, the Laboratory was a private and largely commercial organization for the examination of and report on confidential material of the Marland Oil Company. It was not, however, either built or maintained by the Marland Oil Company. At the end of 1925, commercial work was concluded, and the Laboratory became what its title states: *The Cushman Laboratory for Foraminiferal Research*.

In the fall of 1926, the first two students came to the Laboratory. They were Reginald W. Harris and James A. Waters, both of Harvard. That year the Laboratory was opened to Harvard, Radcliffe, and Massa-



CUSHMAN LABORATORY FOR FORAMINIFERAL RESEARCH

chusetts Institute of Technology students, and an official course for graduate students was established. And so it continued for the next twenty-three years, during which time many came, all travelling out from Cambridge to Sharon to study at the Laboratory and see at first hand the tools and methods of foraminiferal research.

In the spring of 1929 an addition was built onto the Laboratory, a separate room, like a steel vault, separated from the original building by a narrow passage-way with a steel door at each end. The most valuable collections and the library and card catalog were then moved into this steel room as an extra safeguard, and Dr. Cushman moved his work table out into this part. In subsequent years only very minor changes and additions were made to the Laboratory building.

During the twenty-six years since the Laboratory was founded, the visitors, students and workers have been almost too numerous to recall. All brought something which, together, has helped to make the Laboratory the place of inspiration that it has been. A few of the assistants have been outstanding in the length of their service. Miss Margaret S. Moore, of Sharon, artist, worked at the Laboratory from May 1927 to June 1935. Miss Elizabeth C. Knott, of Sharon, was secretary from mid-1930 until the end of 1934. Miss Frances L. Parker, of Brookline, Mass., was first a student from M.I.T. in 1929-30, and then research assistant for the ten years following, 1930 to 1940. Miss Patricia G. Edwards of Berkeley, Calif., and Miss Ann P. Shepard of Sharon, both came in the fall of 1935. Miss Edwards was research assistant until the end of 1939, and Miss Shepard was illustrator until 1940. Miss Ruth Todd of Mercer Island, Washington, came in 1940. Miss Rita J. Johnson of Canton, Mass., has served as laboratory assistant since 1945.

In 1927 Dr. Cushman spoke briefly on the Thornton Burgess radio hour, *Fossils—what they are and their uses to man*, explaining to his audience that “a fossil is not to be looked upon as something that has lost its usefulness, but may after all have been only getting ready for real use.”¹ To this program his collie, Bruce, listened in Sharon with avid interest, mixed with wonder.

In the fall of 1937 a summer home in Randolph, New Hampshire, was purchased, and for the following summers, excepting the war years, certain movable laboratory equipment was transferred by car, and a summer laboratory, complete even to photographic dark-room, was in operation there from June to September. The location was ideal: beside a small waterfall which joined the Moose River at the foot of the slope,

¹ Natural History by Radio. *Fossils—what they are and their uses to man*. Scientific Monthly, vol. 27, Oct. 1928, pp. 346-348.



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1. View inside the Laboratory.
2. Door of the Laboratory in snow-time.
3. View of the Laboratory in summer from the woods, showing the steel room addition at the left.
4. Dr. Cushman at work at the card catalog.
5. Miss Alice E. Cushman at her desk in the Laboratory.
6. The printer's shop in Bridgewater, Mass., about 20 miles southeast of Sharon, where the *Contributions* were originally printed. Dr. Cushman and his brother standing in the doorway.

and overlooking a meadow interval beyond which rose the northern slopes of the Presidential Range. It provided for a most efficient combination of work and play.

The New England hurricane of September 21, 1938, struck while the family was still at Randolph. They found later that a number of the aged pine trees surrounding the Laboratory in Sharon had their tops broken off and thrown onto the roof, but no serious damage was done.

On December 31, 1941, the Laboratory held Open House for visitors during the Boston meetings of the Geological Society of America. Dr. Cushman received many other callers through the years, ranging from visiting foreign scientists to interested Sharon youngsters. He had a collection of exhibits and diagrams designed to make clear some of the aspects of micropaleontology, such as a common pin upon the head of which he had mounted a hundred forams to show their small size, and a stratigraphic column in a glass cylinder, a serial ("cereal") section showing different color, texture, coarseness, etc., in deposition, as represented by a variety of contemporaneous American breakfast foods.

The variety of jobs done at the Laboratory, as well as the new techniques and usages developed, have been notable. Originally, the cardboard slides, both single-hole and faunal, were made by hand at the Laboratory, and many of the specimens are still mounted on these Cushman-made slides. The unit cases and trays, of composition board, were made in the Laboratory. Over 150 such cases (holding 480 slides each) are still in use, in addition to the steel cabinets and wooden cabinets in which are filed the more valuable parts of the collections. During the visit of Dr. Yoshiaki Ozawa of Tokyo, Japan, in 1929, he introduced the use of carbon tetrachloride in floating forams from certain washed samples to facilitate the time-consuming picking process. In the basement photographic room were several cameras, by means of which many of the illustrations for the scientific papers were made, replacing to a large extent illustration by drawing as was originally used.

The card catalog was well under way in 1923 so that it occupied 32 drawers at the time of moving into the Laboratory. Its maintenance has been a never-ending task. Some of the earliest cards were 3 x 5" in size, but very early in the work the change was made to the 4 x 6" size, so that the text and figure, wherever available, could be included on the cards. The cards now occupy 96 drawers and total over 96,000 cards. The Cushman Catalog of numbered slides was started in the early '20's, even before the building of the Laboratory, and has reached beyond the 64,000 mark.

For a time the Laboratory was graced by the addition of a pair of canaries, Pyrgo and Robulus, the choice of their names perhaps reflecting the stand which Dr. Cushman had taken on the controversial question of Defrance's long-unused names. The Laboratory is always graced by the wild birds which come to the window feeder, particularly on snowy winter days. For some years Dr. Cushman operated a bird-banding station at the Laboratory. Accustomed as he was to giving names to Foraminifera, Dr. Cushman frequently assigned suitable names to other creatures, such as the chickadee, recognized by his lame leg, who appeared regularly for food and went unknowingly by the name of Jeremiah Treadwell.

Dr. Cushman's cactus collection has grown to extend all along the four window-sills in the students' room, and has overflowed onto two more window-sills in the northwest room.

Foraminiferal Dinner
<i>Bathysiphon rubrum</i>
<i>Elphidium irishguaeensis</i>
<i>Orbulina viridis</i>
<i>Hippocrepina carrotana</i>
<i>Bolivinoidea edibilis</i>
<i>Spirillina incurvata</i>
<i>Globigerina aurea</i>
<i>Pygulina spinata</i>
<i>Globulina infiltrata</i>
<i>Slidus faunalis</i>
<i>Cafe liquideus</i>
<i>Lagena pseudostriata</i>
<i>Webbinella hemispherica</i>
<i>Leperditia saccharina</i>
Sharon, Mass
February 23, 1940

On various occasions "Foraminiferal Dinners" were given at the Cushman home for the current group of workers and students. On such occasions the menus would be prepared in scientific style by Dr. Cushman, and usually a cake would be decorated by him in the form of a giant faunal- or species-slide. He also constructed the rolls in the shapes of Foraminifera (see *Bolivinoidea edibilis*, *Spirillina incurvata*, and *Globigerina aurea* on the menu of the *Bathysiphon rubrum* [roast beef] dinner).

At the Laboratory also, there were occasional interruptions to relieve the tension of constant microscope work. There was wood to be brought up from the

wood-lots, sawed, and brought in, when it looked as if a storm were brewing, and fruit trees to be sprayed in season. These coöperative projects all engaged in.

On April 2, 1948, the twenty-fifth anniversary of the founding of the Laboratory was celebrated in characteristic Cushman-family style by a small group gathered in the Laboratory. On this occasion Dr. Cushman was presented with a volume of letters as a surprise from his students and colleagues all over the world who had written greetings and congratulations to their well-loved teacher and friend.

JOSEPH A. CUSHMAN — THE TEACHER

Dr. Cushman's teaching methods were unorthodox in that the classes were informal in a friendly atmosphere of unrestraint in comparison with the tenseness existing in many classrooms. This was probably due, in part, to the few graduate students, two to five, who were studying at Sharon during the same period; but largely to the friendly unassuming personality of our foremost authority in the foraminiferal science, who sat among his students teaching them as much of the fundamentals of the science as possible in the few months they were able to spend with him. Dr. Cushman's extreme modesty, which also influenced the student-teacher relationship, invited questions, discussions and ideas from his students. This avenue was opened to them by Dr. Cushman in telling them that he was learning from them while they were learning from him.

Neatness, organization and efficiency were a part of Dr. Cushman's personality, and students not naturally endowed with these traits or previously trained, acquired them through association, observation and suggestions. He knew the value of time, and taught the students to organize their research work from the foundation of the projects through the necessary steps leading towards their objectives in order to obtain accurate conclusions with a minimum of confusion. His inexhaustible patience was evident in working with mentally and physically indolent students and those whose interest in the Foraminifera wavered for various reasons. However, his only humorous criticism was directed at those students who were time wasters, untidy or careless in the organization of their work. This subtle constructive criticism of students' work or their attitude toward their work was fascinating, spurring them to greater and corrective effort. It often took considerable thought and self-analyses by the students to determine whether Dr. Cushman's remarks were purely constructive, or whether there was a hint of criticism behind his twinkling eyes. The enthusiasm with which he worked and discussed the problems connected with the research projects of the various students was contagious, stimulating them to greater effort and deeper thinking.

A complete unit was concentrated in the laboratory at Sharon, Massachusetts for the study of Foraminifera. The library was complete, being augmented by a generic and specific card index file kept up to date. Sectioning and photographic equipment were available to the students,

who were taught to use them. Probably the largest single collection of type outcrop material from the United States, Europe, Mexico, South America and other areas was filed in the laboratory, and the students at odd times prepared foraminiferal slides for the laboratory and for their own files. Films of text and plates of out-of-print foraminiferal publications were available, and most students came away with more than three thousand such photographs.

Dr. Cushman's powers of observation were unusually well developed. He was criticised by some of the English micropaleontologists for cutting the species so closely that they could not differentiate between them. Naturally, beginning students had like difficulty in noting the minute differences in the specific characters of quite similar species. However, using the camera lucida, he could draw in the specific characters of Foraminifera, enabling the students to also detect the minor specific variations, thus increasing their observational powers, and at the same time teaching them to differentiate between specific variations and variations within the species.

The number of students who were fortunate enough to spend some time with Dr. Cushman in the laboratory were few in comparison with the total number of workers who were learning about the Foraminifera from him. The great number of correspondents, co-workers, and co-authors in the United States and foreign countries, many of whom had never visited the laboratory, were also students of the Foraminifera under his guidance.

In the appraisal of students' work, Dr. Cushman did not place too much emphasis on grades, but did emphasize industry, precision, and mental processes. In grading of students' efforts, he was very lenient, giving them the benefit of any doubt that entered into their work or examinations. In discussing the students' work with them, Dr. Cushman could not be misled as to their knowledge of the subject. He was not tolerant of those who bluffed, and insisted that they should always maintain a position of scientific integrity. He was not hesitant in saying "I don't know" if questioned on problems with which he was unfamiliar. He also did not hesitate to defend his stand on problems to which he had given considerable time and thought, and expected his students to do the same. He was neither a professor nor an instructor, but a teacher who enjoyed spreading the knowledge of the science to which he devoted his lifetime, and through multiple channels accomplished it successfully.

JAMES A. WATERS

DR. JOSEPH A. CUSHMAN — AS ONE TO WORK WITH

Dr. Cushman was a person whose mind seemed always to be way ahead. Yet, far from being one who planned things only, his ability to execute his plans with dispatch was remarkable.

His normal procedure in work was first to write down in outline form on a small sheet of paper or card, headed by the name of the project, a series of phrases somewhat as follows:

Wash material
 Float material
 Pick in faunal slides
 Mount individual slides
 { Identify
 { Select for illustration
 Mount for photographing
 Photo — develop — print
 Retouch photos — draw end views
 Make dummy plates — Expl. of plates X
 Black around photos — cut out and black edges
 Paste, number, and letter plates
 Ms. with synonymy from cards
 Descriptions, notes, and measurements
 Catalog slides — insert type numbers
 Type Ms.

A number of such outlines, with the items in various stages of being crossed off, were always on his desk. For he almost never had only a single project under way at a time. Instead, he regularly had as many as five or six or even more separate projects in active process at one time.

The second stage in his work was a long, usually 6- or 8-page, list of all the species and varieties found. This list would be made up during the process of identifying the fauna and would appear somewhat as follows:

COCOA SAND (Spec. Publ. 16)

	Ms. done	Ms. typed	Select for photo	Ph't'd	Ret'ched	Plates
Textulariidae						
Spiroplectammina						
S. mississippiensis (Cushman), var. alabamensis (Cushman)	X		X	X	X	1-3
S. mississippiensis (Cushman), n. var.	X		XX	X	X	1-1, 2
Textularia						
T. cf. hockleyensis Cushman and Applin	X		X	X	X	1-4
Verneuilinidae						
Gaudryina						
G. (Pseudogaudryina) jack- sonensis Cushman	X		X	X	X	1-5

etc.

With such a working chart completed, it was again just a matter of filling in blank spaces and visually seeing progress in the work.

With several projects under way at once, he used colored papers, usually smaller than letter size and frequently as small as 3 x 5", a different color for each different project. His manuscripts were almost all hand-written, and only very rarely dictated.

In collaboration he did his full share, and often more, of the work in any paper of which he was co-author. He was, moreover, open to question and suggestions, and did not necessarily regard his own judgment as final. In reply to a correction of his identification in preliminary manuscript of certain *Radiolaria* as Lagenas, he wrote: "I will carry out the various suggestions you have made as to new species in the Lagenas and we will take out the radiolarians that looked like Lagenas. In fact I think the foraminifera should start a law-suit against the radiolaria for infringing on their patent rights."¹

His workmanship in all things was careful and painstaking. He recognized his own fallibility and there were more than a few occasions when he corrected his own work.

There was no kind of work at the Laboratory that he did not do, at one time or another, even to manufacturing home-made cardboard slides in the early years, and so his understanding of the problems of drawing, of photographing, of picking, of washing, made it easy for him to help others learn these tasks.

Dr. Cushman had fastened to the side of the bookcase above his work table a quotation from a lecture delivered by H. D. Arnold at the Lowell Institute, Boston, on January 5, 1932, which may well represent his own life's work:

Research is not constructing and manipulating; it is not observing and accumulating data; it is not merely investigating or experimenting; it is not "getting the facts"; although each of these activities may have an indispensable part to play in it. *Research is the effort of the mind to comprehend relationships which no one has previously known.* And in its finest exemplifications it is practical as well as theoretical; trending always toward worthwhile relationships; demanding common sense as well as uncommon ability.

RUTH TODD

¹ Personal communication to R. M. Stainforth, Dec. 1, 1944.

JOSEPH A. CUSHMAN
AND THE
UNITED STATES GEOLOGICAL SURVEY*

Dr. Joseph A. Cushman was officially connected with the United States Geological Survey during two periods separated by about five years. The first extended from 1912 to 1921 and the second from 1926 to the time of his death in 1949.

In 1912 Dr. Cushman became a consultant specialist in Foraminifera with the former Section of Coastal Plain Investigations under Dr. T. Wayland Vaughan. In this work he was called upon at frequent intervals for expert judgment in the identification of foraminiferal faunas and the correlation of stratigraphic horizons by means of these faunas. It was early in this period, in 1914, that he was asked to attempt to correlate horizons in wells by means of the foraminiferal faunas — in this instance water sands in wells in South Carolina. Because of the lack of qualified specialists it was some years before wide use was made of this method, but it became eventually and still remains one of the most useful tools of the petroleum geologist and the general stratigrapher. Though Dr. Cushman's work for the Survey in this period was intermittent, a series of pioneer accounts of fossil faunas resulted, published as Professional Papers or Bulletins of the Survey or in outside periodicals.

By 1921 many of the oil companies were interested in the use of micro-paleontology in correlation, and Dr. Cushman was offered highly remunerative opportunities in this field. He decided to accept and, in accordance with federal law, severed his connection with the Geological Survey. Late in the twenties some of the connections with the Survey were re-established, though on a restricted basis. In 1930 Dr. Cushman accepted an appointment with the Section of Paleontology and Stratigraphy as a full-time, regular member of the scientific staff and kept that relationship until his death.

During the period from 1930 to 1949 Dr. Cushman examined many Survey collections of surface and subsurface rocks for their foraminiferal content and made many more or less routine reports on them. Some of his findings were incorporated in published reports by other geologists and some were reflected only in age assignments of rocks in such papers.

* Published by permission of the Director, U. S. Geological Survey.

Some of his routine examinations, however, yielded material of sufficient interest to deserve further discussion, either as descriptions of faunal assemblages or as studies of systematic groups. A long series of published papers was issued by him as Survey Professional Papers, papers in the Contributions from the Cushman Laboratory, publications of State Surveys cooperating with the Federal Survey, and papers in various periodicals. Dr. Cushman had considerable freedom in the planning of his work and the allotment of his time and, as his bibliography shows, used it wisely. He cooperated with many individuals outside the Geological Survey and assumed many obligations beside those directly connected with it, all tending to advance knowledge of the Foraminifera.

Dr. Cushman's enthusiasm for his work was unfailing. His industry was prodigious and his effectiveness as a workman very high. In consequence his output was, as one reviewer put it, incredible. It will stand, nevertheless, as a tremendous contribution to the knowledge of a group of organisms and to the establishment of their use for both practical and theoretical purposes in geology. The Geological Survey is proud of its association with Dr. Cushman in this work.

JOHN B. REESIDE, JR.

JOSEPH A. CUSHMAN AND THE NATIONAL MUSEUM

On the fly leaf of the first edition of his now classic treatise, "Foraminifera, their classification and economic use," that he presented to Miss Rathbun, Dr. Cushman wrote:

To

Dr. Mary J. Rathbun

who more than any other person
is responsible for starting my
serious work on the foraminifera
twenty five years ago with hope
that the confidence then shown
has not been a source of
disappointment and with my
best wishes.

Joe. A. Cushman.

Sharon, Mass.,

June 9, 1928.

Thus, with characteristic generosity, Dr. Cushman dated the beginning of a long, enduring, and mutually profitable association with the U. S. National Museum. This association culminated with his death in the bequest to the Smithsonian Institution of his collections and unsur-

passed library of the literature of foraminifera, and the setting aside of certain rooms within the National Museum for their reception.

In the summer following his graduation from Harvard in 1903, Cushman, who among his scientific interests included paleontology, was digging crustacean remains from the Miocene cliffs at Gay Head, Martha's Vineyard. In the course of that excursion he passed through Woods Hole, not only because it was in those days as now the mecca for biology majors, but because he could also there discuss matters of mutual interest with Miss Rathbun, who had already made her mark as one of the leading American carcinologists and who, as an assistant curator in the National Museum, had charge of the marine invertebrate collections. She spent that summer and the several succeeding ones at Woods Hole, as she had other summers off and on since 1881. It was during her early years at Woods Hole as a young woman that she also acquired her love of the sea and its inhabitants.

From subsequent developments and correspondence we know that Miss Rathbun was much impressed with the young honors graduate and his keen interest in the microscopic forms of life. He had already published something on desmids, unicellular microscopic fresh-water plants, had other papers on them in preparation, and had now, besides his paleontological endeavors, become interested in the ostracods and foraminifera of the Woods Hole region. About this time also he had embarked on the study of a small collection of Pleistocene foraminifera from Panama.

Good curator that she was, Miss Rathbun saw here an opportunity of introducing a young man of great promise to the vast and largely unworked collections of marine deposits rich in foraminifera, which were lying fallow in the national collections. Indeed, Cushman himself may well have brought up the subject, for his principal guide and reference work in his study of the Panama collection was Flint's "Recent Foraminifera,"¹ based on the Museum collections and representing one of the first substantial efforts made toward describing them. Needing representative recent species for comparison with his Panamanian Pleistocene specimens, Cushman, in February 1904, made his very first request of the Museum for portions of some of the *Albatross* samples that had been studied by Dr. Flint. Material from 9 stations was sent him at that time, 2 additional vials in March, and 23 more in November, along with a gift copy of Sherborn's Index.

¹ "Recent Foraminifera. A Descriptive catalogue of specimens dredged by the U. S. Fish Commission Steamer *Albatross*," Ann. Rept. U. S. National Museum for 1897, pp. 249-349, 80 pls., 1899.

Following further encouragement from Miss Rathbun, Cushman wrote to the Museum authorities for permission to work up their accumulated recent material, stating that he intended to continue with the foraminifera and make their study his life's work. Not only had he by that time assembled a great many recent species with the Museum's assistance, but he had studied a number of fossil forms from Europe and America from various geological formations as well. At the Boston Society of Natural History, where by this time he had been employed as assistant curator, he had access to most of the necessary literature. His letter concluded with these words: "I appreciate the fact that the task is an immense one, yet I would like to undertake it if satisfactory arrangements can be made." These were made quite promptly, for, supported by strong recommendations from Miss Rathbun and with Dr. Flint's assent, there was no hesitation in granting his request. The Museum, which could not undertake to segregate the material other than by localities, offered him his choice of North Atlantic or North Pacific material, with the suggestion that "the latter region might possibly furnish the greater number of novelties." He was also informed at the time that the Museum was not in a position to offer him compensation for working up the material, but that it would expect to publish his paper and issue new discoveries with some promptness in advance of the complete report. The illustrations, the Museum presumed, "could be made by photography."

Cushman was happy to accede to the conditions set, and at once took up with the idea of first working up the North Pacific collections. He, too, felt that they would prove the most interesting, warning, however, that his progress would necessarily be slow, because he could not devote his whole time to the work. He hoped that the Museum would take the photographs needed, for he lacked the experience, equipment, and the means to defray their cost. This the Museum did, undertaking also to furnish the vials needed for sorting and storing the clean samples, the slides, covers, and brass clips for mounting specimens for the permanent collection. The now long obsolete wooden slides with sheet mica covers were the best things available in those days and were still in use by the Museum as late as 1917. The standard paper slides favored today were not generally adopted until about 1920, although Cushman as early as 1910 himself employed heavy paper slides, blackened in the center, to mount the duplicates he was permitted to keep for his own use and for future reference. Though he received no direct compensation from the Museum, small grants were made from time to time to defray the cost of

the mere labor of washing samples, selecting specimens and mounting them for the National Museum, and making such drawings in addition to the photographs furnished as were needed to properly illustrate the species, particularly the smaller forms.

The initial installment of the North Pacific collections was sent to Boston on March 31, 1906. This was the first of a long series of shipments of marine sediments and bottom dredgings that continued over more than four decades until Cushman's last serious and fatal illness. No one will ever know the endless hours he put in on that material. At first he gave it just his spare time and overtime, with a very great deal of the latter, for, besides curating at the Boston Society, he was working toward his doctorate at Harvard. In the last of his postgraduate years he wrote the Museum that he hoped to work faster the following year when free of scholastic obligations and perhaps then mount as many as 4,000 slides. On June 8, 1909, he confessed in a letter to Miss Rathbun that he nearly neglected to take his examinations for his doctor's degree, but that he had passed them the day before.

Meanwhile, the material that was being collected by the *Albatross* in the Philippines was beginning to come in. This, too, had to be washed, sorted, and mounted. Due to Cushman's unremitting efforts, the Museum's collections were growing by leaps and bounds. He was so greatly impressed by them that as early as June 1910 he ventured that "the [Museum's] foraminifera collection is now I suppose the largest in existence and will be unapproachable when the other collections [that the Museum was making available to him] are worked up." With reference to some of the Philippine samples, he was moved to remark in the spring of 1913 that they were "about the richest ever collected, perhaps excepting some that the *Challenger* had secured in Torres Straits." As he went along, he checked over the collections of other workers existing in the Museum, no mean task in itself. The work of Flint and Goës he found uniformly good and reliable.

So great was his interest and, indeed, his love for the work that twice he passed up opportunities of bettering himself elsewhere, at Yale at one time, and at another in Honolulu with Dr. Gregory. On the first of May 1915 he went so far as to cut in half the time he gave the Museum of the Boston Society of Natural History, so that he might devote the other three days a week, with as much time out of hours as possible, to continuous work on the collections of the National Museum. "With this decision," he said, "I am going to have a place at home where I can have all things in shape for such work." With this he initiated the beginning,

if not the founding, of the Cushman Laboratory for Foraminiferal Research, although the designation may not yet have taken shape in his mind.

In all his dealings with the Museum, Cushman was ever appreciative of the least assistance. The only times he ever evinced impatience were when the sendings of material did not keep pace with his cleaning, sorting, and working it up, or did not enable him to keep busy such assistants, volunteer and otherwise, as he was able to enlist from among his immediate family, relatives, and friends. During the time that he was busy with the rich Philippine collections he was forever after the Museum to "hustle" samples along, as well as the slides and covers needed to mount selected specimens. He himself always cheerfully, energetically, and hopefully moved the work along even when the limited grants extended him for drawings and slide mounts fell short of the number of drawings or mounts produced within the period for which the grant was made.

Starting with a grant of \$50 in 1906, the total paid Cushman for mounted slides and drawings in the next six years was less than \$2500. For this sum he mounted over 4,000 slides of forams for the permanent reference series, starting with crude bottom samples, and made well over 1200 drawings for the reports in which the specimens were described. This takes no account of the manuscripts prepared in which the species were described. In later years the parts of the several Museum bulletins in which the results of his studies were published were contracted for at the rate of \$1200 per part, a figure that included the illustrations as well as a representative set of mounted specimens. Never was more than one part contracted for in any one year, and often, because of shortages in the always limited appropriations, several years intervened before the Museum was able to arrange the payment for the next part. The small sums that Cushman received from the Museum scarcely reimbursed him for moneys he himself expended in the hire of assistants.

As his various studies on foraminifera progressed he needed more and more time for the critical work of selecting and describing specimens, and so was forced to employ the services of an artist, although he himself was an accomplished scientific and creative artist in his own right. Always the inspired worker, he never permitted disappointments arising from lack of funds to discourage him. It has always been and still is a difficult matter to convince the appropriating powers in Washington that purely scientific studies should be supported for their own sake. One can never foretell when some seemingly not very important scientific

contribution to knowledge may become of incalculable economic value. The forams are a case in point. Years before their significance in oil prospecting was appreciated there was the same difficulty in justifying the funds expended in supporting Cushman's studies. Cushman was well aware of the prevailing situation, for in a letter to Miss Rathbun in the spring of 1909 responding to one from her apologizing for the Museum's lack of liberality in the matter of funds he wrote: "I am exceedingly sorry that the lack of appropriation should be laid to New England, yet I realize thoroughly that New England's ideas of economy are not at all times real economy. It certainly is too bad that scientific endeavor is not more recognized, except in cases of very apparent economic subjects which in turn are absolutely dependent upon the purely scientific side for their basis. It is strange that so many people fail to realize this. We have plenty of it right here in Massachusetts."

In this letter he expressed himself as "extremely appreciative of the kindness of the Museum authorities for their help in carrying on the work and their interest in it. In fact," he wrote, "the kindness and interest shown in my work, although so far removed from the Museum, has been a decided source of inspiration to me, for I have had little of it here. I am sure that the final results will justify the interest the Museum has taken in the work." This sentiment he repeated many times by letter and word, in the inscription on the fly leaf of the copy of his original foram text that he gave Miss Rathbun, and by the fact that his entire lifetime collection of forams and superlative library dealing with them were willed to the Smithsonian so that they might find their last resting place in the Museum to which he felt he owed so much.

Without access to the Museum's great collection of bottom samples and dredgings from all oceans, gathered chiefly by the former U. S. Bureau of Fisheries Steamer *Albatross* in the Pacific and North Atlantic, Cushman might never have acquired the broad background of basic knowledge of, or gained the wide first-hand experience in working with foraminifera that made him without question the leading authority of all time on their kinds, classifications, distribution in time and space, and paleontologic importance. On the other hand, the national collection of foraminifera would not be what it is today—the finest, most complete, and best organized in existence—had it not been for Cushman's keenly analytical and methodical mind, his intuitive understanding and uncannily broad grasp of the problems presented by its identification and systematic organization, his unremitting labors, his many personal sacrifices, and his contributions of additional material received as specialist

or personally acquired during several trips abroad to study the foraminifera at their type localities or those contained in foreign museums.

By the close and intimate association existing between Cushman and the staff of the Museum concerned with both fossil and recent invertebrates over a period of 45 years the National Museum gained in prestige and in the enhancement of its collections far beyond the modest sums and personal assistance provided him. Cushman himself was one of the most rewarding and became one of the most eminent of the many students assisted by the Museum in accordance with the Smithsonian's traditional policy of furthering the increase and diffusion of knowledge among men. Geologic and paleontologic science gained immeasurably by the present-day development of micropaleontology, of which field of study Cushman has quite justly been recognized as the father. In the last quarter of a century the oil and related industries and the Nation gained untold wealth as the result of the study of these organisms in the Museum's collections initiated by Cushman and carried on with the Museum's encouragement solely for the sake of knowing more about them, with no thought of monetary gain and at a time when foraminifera had no known or demonstrable economic importance.

WALDO L. SCHMITT,² Head Curator
Department of Zoology
U. S. National Museum

March 28, 1950

² I became acquainted with Dr. Cushman when I first went to work as an assistant to Miss Rathbun in the Division of Marine Invertebrates back in 1910. The friendship then formed was a happy one. We had many discussions of his problems and, indeed, of his plan to bequeath his library and collection to the Institution before he ever broached the matter officially. I was honored to learn of the high regard in which he must have held this friendship when I was told after his death that, in his plans for this memorial volume, he had indicated his desire that I contribute a few words about his association with the Museum.

THE CUSHMAN LABORATORY AND HARVARD UNIVERSITY

In the early nineteen twenties, students began to arrive in the Harvard Graduate School with some knowledge of the contribution being made by micropaleontology to the petroleum industry. They were aware of the pioneer work with Foraminifera that was going forward in the Cushman Laboratory and they correctly appraised the value of this type of research to petroleum geology. It was therefore quite natural for them to seek an opportunity to study under Dr. Cushman in his laboratory.

At first, two or three such students made unofficial and entirely personal arrangements with Dr. Cushman to work in the Sharon laboratory. The theory was that they would repay him for his instruction by assisting in the mounting and filing of specimens, but I am sure that each of them would vigorously assert that he had received far more than he could possibly have repaid. As the news began to spread that Dr. Cushman was more than willing to enter into such a bargain, unfair though it might actually be, more and more of the Harvard students turned long-eyes toward Sharon. Professor Raymond recommended to the faculty of the Department of Geology that an effort be made to place the informal instruction on a regular academic basis. It was a modern scientific version of the time-worn story of the man who made the better mousetrap.

Accordingly, in September 1926, Dr. Cushman was appointed Lecturer in Micropaleontology at Harvard University, and much to the delight of all concerned he accepted the appointment even though no salary could be offered him. "Research in Micropaleontology" was announced as one of the courses in the departmental program, and each year, beginning with 1926-27, from one to five students were enrolled "with the consent of the instructor." Although Dr. Cushman's appointment might have been referred to as "Honorary," he accepted its full responsibility and gave himself unstintingly to it. It was soon evident that he was just as painstaking and successful a teacher as a research worker.

At first, this relationship between Dr. Cushman and Harvard was on an annual basis, but in 1939 the title of the appointment was changed to Research Associate in Micropaleontology, and the arrangements were

placed on a permanent basis, although still no monetary remuneration was involved. Thus, for twenty-three years Dr. Cushman made himself and the resources of his laboratory available to Harvard students, adding tremendously to the prestige and effectiveness of the Department of Geology. Only the men who profited from the instruction they received by virtue of this extraordinary relationship can appreciate fully the unpaid and unpayable debt that Harvard owes to Joseph Cushman.

KIRTLEY F. MATHER

JOSEPH A. CUSHMAN: IN RETROSPECT

When I arrived in Cambridge in 1912, the name Cushman was new to me. I found him over in the dusty rooms of the Boston Society of Natural History, where he was a Curator. He was a quiet, unassuming young man, curiously enthusiastic about Foraminifera. All that I knew about these creatures was that some of the pyramids were built of nummulitic limestone, and that myriads of small specimens occurred in Mesozoic and Tertiary strata. But I had been warned against wasting my time on them. An eminent authority had published a paper on Palaeozoic forms and had shown that among them were genera, and perhaps species, indistinguishable from Tertiary and even Recent ones.

At that time Cushman had been studying the Foraminifera intensively for more than a decade, and had worked on material collected over a considerable vertical range. He justified his enthusiasm by pointing out that although there were many Foraminifera which resembled each other greatly in general habit, yet there were great differences in the forms of the apertures, and that it was possible not only to distinguish species if good material were properly studied, but that many of the genera and species had relatively short ranges. He was convinced that they could be used in the identification of stratigraphic zones. In 1914, he had an opportunity to demonstrate the truth of this prediction.

Companies drilling for oil in Tertiary deposits were constantly bringing to the surface immense quantities of Foraminifera but only few macroscopic fossils in condition to be identified. At last one company, prospecting a large property, got the idea that the micro-fossils would prove useful. Strange as it seems now, they had to hunt for a man who knew Foraminifera. They asked Schuchert, Schuchert asked me, and, naturally, Cushman was selected. Fortunately, the company was willing to spend money and take advice. The story of that exploration has often been told. Cushman and his "forams" jumped suddenly from obscurity into the limelight. Once again pure research of no commercial value had produced a tool of great economic importance.

Most paleontologists would have capitalized on this success and its resultant opportunities to make money, but Cushman was more interested in research than in monetary rewards. He did continue in consulting work for a short time, investing his earnings in building an ade-

quately equipped laboratory and taking two trips to Europe to study classic sections and the types of the older species. But he soon made a connection with the U. S. Geological Survey as a "dollar a year" man, purely to have a good excuse for not accepting commissions. Everyone knows his devotion to his laboratory, the great collections he accumulated there, the numerous students he trained, and the amount of research he accomplished.

He was devoted to his Alma Mater, Harvard, serving for years on the Visiting Committee of the Division of Biology, and as a Lecturer in the Division of Geology. In the latter position, he paid his own salary. He also took students from the Massachusetts Institute of Technology, and Radcliffe College, all instruction being carried on in the laboratory at Sharon.

In spite of his devotion to his special subject, Joe was no recluse. He was modest, sincere, a good friend and a good companion. He was a man and a true scientist.

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1927

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1929

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